New York State Integrated Pest Management Program | Cornell Cooperative Extension

Zinc Profile

Active Ingredient Eligible for Minimum Risk Pesticide Use

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Label Display Name: Zinc

Active Components: Zinc

CAS Registry #: 7440-66-6

U.S. EPA PC Code: 129015

CA DPR Chem Code: 2310

Other Names: Asarco; Jasad; Merrillite; Rheinzink; Elemental Zinc; Cinc (Spanish)

Other Codes: CCRIS 1582; Merck 10180; UN1435; HSDB 1344; RTECS: ZG8600000; SMILES [Zn]

Summary: Zinc is a common metal that serves many functions. When zinc strips are applied to shingles and roofing to prevent the growth of moss, algae and other organisms, zinc has a pesticidal use. These structural uses of zinc present no known human health or safety concerns.

Pesticidal Uses: Antimicrobial, fungicide, algicide, de-mosser.

Formulations and Combinations: Most exempt zinc pesticide products are 100% technical grade zinc in metal strips. Roofing formulations may be alloyed or sheeted with other rust-resistant metals, such as copper, titanium and aluminum. Registered pesticide products may contain unreacted elemental zinc as a stated active ingredient, including the fungicides mancozeb and ziram. These non-exempt formulations are beyond the scope of this review.

Basic Manufacturers: All-American Metal Products; Farnam; Kanebo USA; Minnesota Mining and Manufacturing.

Safety Overview: Zinc metal strips are relatively inert and non-reactive. Zinc is an essential nutrient for plants and animals, and the EPA required no dietary risk assessment for it (McLain 2012). Zinc is not allowed for use as a pesticide on food crops.

Background

Elemental zinc is a blue-white metal that is mined and refined from various ores. It is used to galvanize sheet iron and steel, and is an ingredient in various alloys such as brass, bronze, and Babbitt metal (Merck 2015). It is abundant in nature, making up about 76 ppm of the earth's crust. Zinc is an essential trace element in plant and animal nutrition, with some therapeutic properties (Merck 2015). The most significant chemical property of zinc is its high reduction potential (Goodwin 2006).

Several different forms of zinc are used as pesticides, including zinc chloride, zinc oxide and zinc sulfate. Section 25(b) of FIFRA limits the exemption to zinc metal strips consisting solely of zinc metal and impurities. The primary use of zinc metal strips is on shingles for the prevention of moss, algae and various microorganism growth. The EPA states that zinc is for non-food use only and cannot be applied for food uses (US EPA 2015b).

Chemical and Physical Properties

The physical and chemical properties of zinc appear in Table 1.

Table 1

Physical and Chemical Properties of Zinc

Property	Characteristic/Value	Source
Molecular Formula	Zn	(EMBL 2015)
Atomic Weight	65.38	(Merck 2015)
Percent Composition	Technical Grade: 99.95% Zn	(Platts 2014)
Physical state at 25°C/1 Atm.	Solid	(US NLM 2016)
Color	Blue-white	(Milne 2004)
Odor	Odorless	(Roney et al. 2005)
Density/Specific Gravity	7.13 g/cm^3 at 25°C	(US NLM 2016)
Melting point	419.5°C	(Merck 2015)
Boiling point	908°C	(Merck 2015)
Solubility	Insoluble in water	(Merck 2015)
Vapor pressure	0.1 kPa at 487°C	(US NLM 2016)
pH	Not found	
Octonol/Water (K_{ow}) coefficient	-0.47	(EPI 2012)
Viscosity	N/A	
Miscibility	N/A	
Flammability	Not found	
Storage stability	Stable in dry air	(US NLM 2016)
Corrosion characteristics	Not found	
Air half life	Stable	(Merck 2015)
Soil half life	720 hrs	(EPI 2012)
Water half life	360 hrs	(EPI 2012)
Persistence	182 hrs	(EPI 2012)

Human Health Information

Acute Toxicity

The acute toxicity of zinc appears in Table 2.

Table 2

Acute Toxicity of Zinc

Study	Results	Source
Acute oral toxicity	Rat LD_{50}: 630 mg/kg	(HSDB 2015)
Acute dermal toxicity	Not found	
Acute inhalation	Not found	
Acute eye irritation	Mild eye irritant	(McLain 2012)
Acute dermal irritation	Mild skin irritant	(McLain 2012)
Skin sensitization	Non-sensitizer	(McLain 2012)

Sub-chronic Toxicity

Sub-chronic toxicity data for zinc was not found.

Chronic Toxicity

The chronic toxicity of zinc appears in Table 3.

Table 3

Chronic Toxicity of Zinc

Study	Results	Source
Chronic toxicity	Negative	(Roney et al. 2005)
Carcinogenicity	Non-carcinogenic (Category D)	(HSDB 2015)
Combined chronic toxicity & carcinogenicity	Not found	

Zinc is not identified as carcinogenic by the International Agency for Research on Cancer (IARC 2014). Elemental zinc is not on the California Proposition 65 list of known carcinogens (Cal-EPA 1997) and does not appear on the Toxics Release Inventory (TRI) Basis of OSHA Carcinogens (US EPA 2015a).

Human Health Incidents

No human health incidents involving zinc metal strips as an active ingredient were reported to the National Pesticide Information Center (NPIC) between April 1, 1996 and March 30, 2016 (NPIC 2016).

Environmental Effects Information

Effects on Non-target Organisms

The effects of zinc on non-target organisms are summarized in Table 4.

Table 4

Effects of Zinc on Non-target Organisms

Study	Results	Source
Avian Oral, Tier I	Mallard ducks (*Anas platyrhynchos*) LD_{90}: 3,000 ppm	(Gasaway and Buss 1972)
Non-target plant studies	Not found	
Non-target insect studies	Not found	
Aquatic vertebrates	Rainbow trout (*Oncorhynchus mykiss*) 96 hr LC_{50}: 800 µg/L (soft water)	(Santore et al. 2002)
Aquatic invertebrates	*Daphnia magna* 48 hr EC_{50}: 3.51 µM	(Heijerick et al. 2002)

Although zinc is an essential nutrient for plants and animals, excessive zinc can be toxic. The toxicity of zinc is dependent on several environmental conditions. Water pH is a significant factor for toxicity to aquatic organisms. Zinc toxicity decreases in both acidic and alkali conditions, and the lowest LC_{50}s occur for rainbow trout (*Onchorhyncus mykiss*), fathead minnows (*Pimephales promelas*) and *Daphnia magna* under neutral conditions (Santore et al. 2002).

Because elemental zinc is an algicide, bactericide, fungicide and moss killer, its release into the environment will have adverse effects on these organisms. Elevated zinc in surface waters have been linked to short-term (Admiraal et al. 1999) and long-term (Paulsson 2000) disruption of algal populations.

No animal incidents involving zinc metal strips as an active ingredient were reported to NPIC between April 1, 1996 and March 30, 2016 (NPIC 2016).

Environmental Fate, Ecological Exposure, and Environmental Expression

The leaching, photodegradation and biodegradability of zinc are summarized in Table 5.

Table 5

Environmental Fate, Ecological Exposure, and Environmental Expression of Zinc

Study	Results	Source
Leaching series	Not found	
Photodegradation in water	Not found	
Photodegradation in air	Stable	(Merck 2015)
Photodegradation in soil	Not found	

While zinc is not biodegradable, it is taken up by a wide range of microorganisms, plants and animals because it is an essential element for most life forms (Roney et al. 2005).

Environmental Incidents

There is extensive literature on the release of zinc into the environment. However, most of the literature is about the disposal of zinc as an industrial by-product and not the application of zinc metal as a pesticide. To estimate the impact of zinc roofing on water quality, one study found 100% of surface water samples taken in Nacogdoches, TX exceeded the EPA limit of zinc concentration (Chang et al. 2004). While

the amount of zinc shedding from roofing material varied by orientation and age, zinc concentrations from new wood-shingle roofs were significantly higher than those from aged roofs. A subsequent laboratory study that simulated weathering showed zinc concentrations in runoff water was higher from new roofs as opposed to older roofs: 16,500 mg/kg leached from the galvanized metal roofing and 11,900 mg/kg leached from the replicated galvanized metal roofing (Clark et al. 2008). Both were over 1,000 times higher than any ungalvanized roofing.

No incidents involving zinc metal strips as an active ingredient were reported to the National Pesticide Information Center (NPIC) between April 1, 1996 and March 30, 2016 (NPIC 2016).

Efficacy

Algicidal and Demossing Activity

Zinc metal strips are used to prevent growth of moss, algae and microorganisms on roof surfaces (Berdahl et al. 2008). Most efficacy citations regarding zinc's bactericidal and algicidal properties are contained in the patent literature (Rapaport 1969; McMahon 1970; Little 1975). Zinc strips and flashing have been observed to suppress the moss *Dicranoweisia* spp., other mosses and fungi at a distance of up to 15 feet, and over multiple years' time (Jackson et al. 2000).

Standards and Regulations

EPA Requirements

EPA has not set any tolerences or granted any exemptions from a tolerance for zinc metal or any of the zinc salts (McLain 2012). Zinc may not be used on food crops as neither a tolerance nor tolerance exemption has been approved (40 CFR 180).

FDA Requirements

Zinc is an essential nutrient mineral. The FDA Generally Recognizes As Safe zinc chloride [21 CFR 182.8985], zinc gluconate [21 CFR 182.8988], zinc oxide [21 CFR 182.8991], zinc stearate [21 CFR 182.8994], and zinc sulfate [21 CFR 182.8997].

Other Regulatory Requirements

Zinc is not allowed as a pesticide by the USDA's National Organic Program (NOP) [7 CFR 205] and has not been petitioned to determine its status. However, structural uses that are not in contact with crop or soil appear to be outside the scope of the organic standards.

Literature Cited

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